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**Report on a Sample of Skin and Hair
from the Khumjung Yeti Scalp**

The following report is based on detailed examination of a small sample of skin and hair from the margin of the " Yeti Scalp ", and comparison with similar small samples from the margins of dried skins of Serow, Blue Bear and Black Bear, all obtained at the conference in London on 23rd December, 1960.

General Features and Fibre Arrangement

Under a low magnification (20x) the skin of the " Yeti " is seen to bear a distinctive type of coat. There is a sparse outer coat of extremely coarse fibres and a greatly contrasted under coat of fibres which are both short and fine. The fibres are spaced widely apart in the skin and emerge singly, with the exception that in a few instances two of the smallest fibres emerge together. The coarse fibres, and to a less extent the fine ones, emerge with a very acute angle of slope so that their ental side lies near the skin surface. The medulla of the coarse fibres is wide and can be discerned even at this magnification.

The whole of the " Yeti " skin (both external and internal surfaces) is covered by a dark brown deposit somewhat reminiscent of dried blood in appearance. This deposit is irregular in thickness and granular in appearance, with white crystals showing among it. All the fibres are dark yellow-brown throughout and are partly encrusted with the deposit.

The arrangement and size of the fibres of the " Yeti " very closely resemble those of the Serow, except that in the latter some of the fine fibres are of considerable length. In both Blue and Black Bear the fibres emerge in bundles and do not correspond in size or arrangement with those of the " Yeti ". The coarse " Yeti " fibres show " flagging " (splitting at the tip as commonly seen in hog bristle), a somewhat unusual feature which

is however thought to be partly due to age and brittleness : some of the Serow fibres also show slight flagging.

Several fairly long and very fine, non-medullated fibres were found entangled with those attached to the " Yeti " skin but not emerging from it. These were either white or dyed bright red and are considered to be contaminants. However, some of the long fine white fibres on the Serow skin are very similar and are certainly not contaminants.

As seen in whole mounts in benzene or liquid paraffin, the pigment granules of the Serow are very small and arranged in short rows in the cortex, with a few scattered, and are absent or sparse towards the margin of the cortex. In colour they are sepia-brown and where they are numerous a general reddish-brown diffuse colour extends through the cortex. This diffuse colour is absent from the proximal ends of the fibres, which are unpigmented, and from the peripheral region except in the most heavily pigmented parts of the fibres (towards the tip) ; it is thus probably reflected from the pigment granules, and not true diffuse colouring. The fine fibres of the Serow show no colour and no pigment granules, except some of the shortest fibres which have deeply pigmented tips.

In contrast, all the " Yeti " fibres (except the few believed to be contaminants) are coloured a deep reddish-brown throughout although pigment granules can only be seen in certain parts (in the coarse fibres towards the tip, and a few in the cortex low down often visible at one side only). It is thought that this diffuse colour is due to some sort of staining or dyeing, despite the fact that in colour it is indistinguishable from the apparent diffuse colour in heavily pigmented regions of the Serow fibres.

Unfortunately it has not been possible to elucidate the nature of the stain and deposit on the " Yeti ". Fibres showing the stain throughout, and partly covered with deposit were immersed for a few minutes in the following reagents without any effect being apparent under the microscope :

- (1) Absolute alcohol slightly acidified with HCl.
- (2) Water
- (3) Concentrated aqueous NaHCO_3 , soln.
- (4) Benzene.

(5) Ether (slight break-up of deposit apparently due to diffusion currents).

Boiling in 17% KOH soln. dissolved part of the deposit but did not entirely remove the stain from the fibre. Immersion in H_2O_2 soln. (10 vols.) for one week bleached the diffuse colour in a "Yeti" fibre to yellow but did not affect the pigment of a Serow fibre.

Medulla

In the "Yeti" medulla is absent from the finest fibres and those a little coarser have interrupted medulla. Amongst the coarse fibres there is a wide range of diameter (roughly 100 to 200 microns), and the medulla of the coarsest fibres is relatively wider than that of the less coarse fibres of this group. The medullary structure is somewhat obscure but appears to be the same in all the coarse "Yeti" fibres. The cortex is thick in all fibres. In cross-section there are some indications of a reticulate structure but in whole mounts it appears more like a "simple" medulla (Wildman 1954). The medullary substance stains green with Picro-indigo carmine and not yellow as would be the case if it was of cortical origin (cf. Hill et al, 1959). It was found difficult to dissolve the cortex and retain the medulla by boiling in 17% solution, because the cortex was almost as resistant as the medulla; however, some small lengths of medulla were isolated by this method. They give the impression of a central solid strand with lateral septa coming out obliquely rather like the branches of a fir-tree, and joined together by thinner divisions leaving small holes between. However it is impossible to be certain of this structure from these preparations.

The medulla of the coarse Serow fibres is about equal in width to the cortex and has a fine reticulate structure, approaching uniserial form in parts. It can readily be separated from the cortex by boiling in 17% KOH solution. The broad medullae of the Yeti fibres distinguishes them sharply from the fibres of Bear, Gorilla and Man, in all of which the medulla is narrow, simple, and frequently interrupted.

Fibre Cross-Sections

Cross-sections of "Yeti" and Serow fibres examined under the optical microscope show a similar range of size, shape, and medullation, as far as can be judged from the small number of fibres sectioned. A significant similarity is that the larger fibres of both samples tend to develop cracks running radially across the cortex from the margin of the medulla. This may be connected with the tendency of the fibres to "flag" at their tips.

A greater proportion of heavily pigmented fibres occur in the Serow fibres, and in the majority whatever pigment granules are present are distributed in the cortex evenly around the medulla; a few fibres, however, show some tendency to asymmetrical arrangement of pigment granules, and in one large, heavily pigmented, and strongly medullated fibre pigment granules are absent from a small segment. In the "Yeti" sections asymmetrical pigment arrangement in some of the fibres is much more marked than in any Serow fibres observed. In these, which are medullated fibres of fairly large size, most of the cross-section is unpigmented and pigment granules are present in one area of the section only; they are sparsely clustered in the inner part of the cortex at one side (Pl. IIa). Other more heavily pigmented sections show pigment distributed evenly all round or with only slight tendencies to asymmetry as seen in the Serow sections. In both Serow and "Yeti" the fibres tend to have an unpigmented region around the periphery of the cortex.

Those medullated fibres of the "Yeti" which show marked asymmetry of the pigmentation closely resemble in appearance certain fibres of *Cebus apella* as illustrated (Hill et al 1959). Asymmetry of pigmentation has been reported in fine non-medullated fibres of some domestic sheep, where it is confined to the paracortex; and in American bison and Musk Ox (Wildman 1954), where it is distinct in the non-medullated fibres and present to some extent in the coarse medullated ones. This suggested comparison of the "Yeti" with the Yak but asymmetrical pigmentation was not shown in any of the few Yak fibres of which cross-sections were prepared. The cuticular scale pattern of the large Yak hairs shows slight resemblance to that of

the large "Yeti" fibres, but this is not thought to be of importance to the present enquiry.

Cuticular Scales

Seen in whole mounts, the coarser fibres of the "Yeti" have a smooth outline, as do those of the Serow, but the scale pattern can be much more readily seen in the "Yeti" fibres despite the staining and deposit. In the fine fibres of both the scale margins are a little more prominent, but the scale pattern does not appear distinctive and casts were not made.

Casts of large "Yeti" fibres show a scale pattern which may be described in Wildman's terminology as "Interrupted waved with small crenations and scallopings, margins near to distant". A similar verbal description would cover the pattern of the Serow except that the margins are "close to near". In the Yak the margins are "near to distant" as in the "Yeti", but crenations are more regular and numerous. None of the illustrations given by Wildman (1954) or Appleyard (1960) corresponds exactly to the pattern of the "Yeti" scales. (Pl. I).

The cuticular scale pattern is not by itself a good diagnostic feature as it tends to vary as much with fibre size as with species, and as so few "Yeti" fibres were available it is not possible to regard them as differing decisively from Serow Fibres.

Recent work by the author has shown that cuticular scale patterns can be artificially altered by abrasion of the fibre surface, and that similar changes occur naturally due to weathering etc. According to these observations the scale pattern of the large Serow fibres could be derived by abrasion from those of the Yeti but not the converse: therefore if they both originally had the same scale pattern the fibres of the «Yeti» must have suffered less damage than those of the Serow. This is in conformity with the sharper scale edges of the «Yeti» fibres and rather reduces the probability of their being of very similar origin.

Collagen Fibres of the "Yeti" scalp were examined under the electron microscope by Mr. A. Millard and showed no unusual or abnormal features, and no indication that the scalp had been treated in any way which affected the appearance of the collagen.

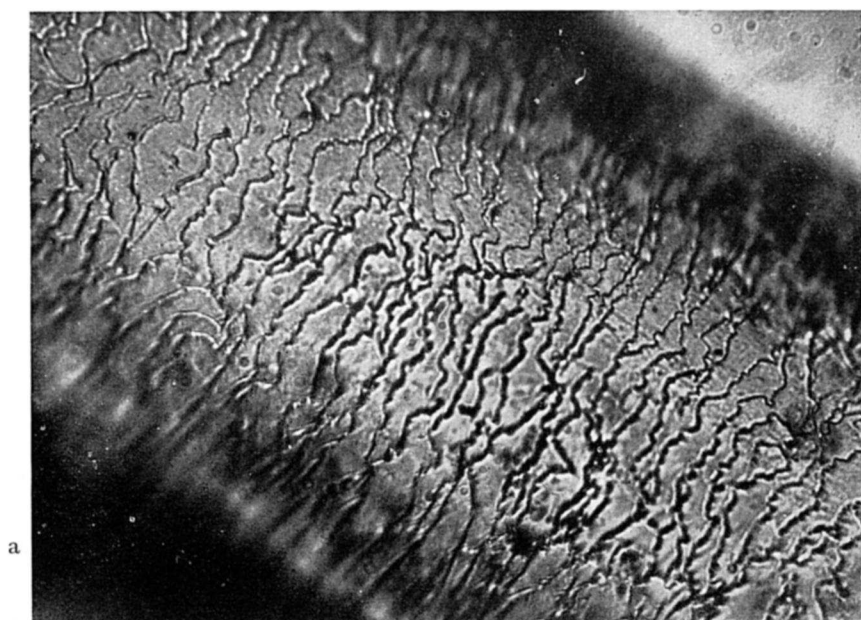
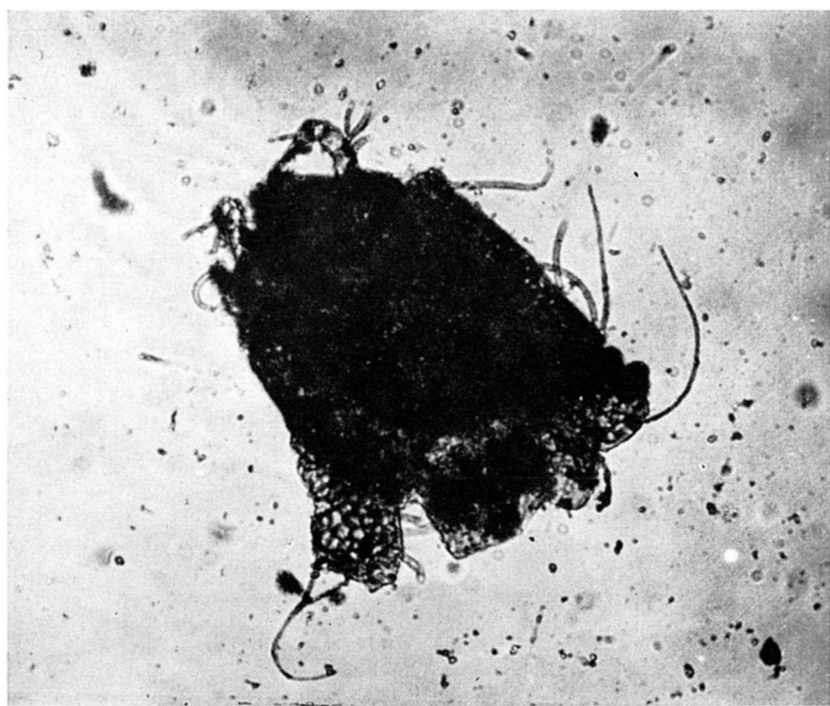
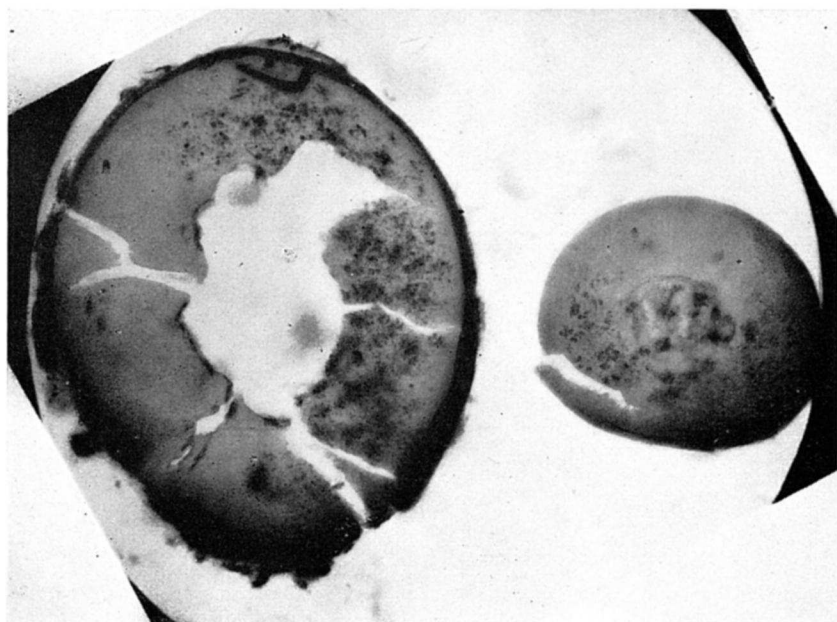


Fig. 1



a



b

Fig. 2

Histology of the Skin

Vertical skin sections of "Yeti" and Serow showed, as with so many other features of this material, striking similarities and indecisive differences.

Both show a thin epidermis with stratum corneum (more pronounced in the Yeti) and two distinct layers of dermal connective tissue; the outer layer being thin, dense and with horizontally-running connective tissue strands, whilst the proximal layer is thick, open and irregular in structure. In the "Yeti" sample the follicle bulbs are entirely confined to the outer layer, large and small follicle bulbs being at the same depth. In the Serow the larger follicles have their bulbs in the deeper connective tissue layer and some small follicles overlap the two layers, between which the division is less distinct than in the "Yeti". These differences are such as could be found between different coat growth phases, different body positions, and different individuals, yet they could have a wider significance.

Ectoparasites

Egg cases of lice are numerous on the Serow sample, mostly attached near the bases of the coarser hairs. These egg cases are empty with the operculum missing, and no specimen of louse could be found. The egg cases resemble those on a sample of Chinese goat-hair available here, but are slightly smaller (about 20 microns less in length). On the "Yeti", one damaged egg-case was found on a detached hair, and a number of lumps on the hairs attached to the skin are thought to be the remains of egg-cases covered by deposit. No lice were found, which may indicate that the "scalp" skin cooled naturally, allowing the lice to leave it, before being immersed in whatever agent caused the staining and deposit.

Mites were found on both samples. On the Serow, diligent search revealed only two specimens, which appear to be *Chorioptes bovis*, one male, one larval female. On the "Yeti" they were rather more numerous but very fragile. Four reasonably intact specimens were mounted and differ sharply from those on the Serow in the following particulars:

(1) All specimens show a conspicuous reticular pattern all over the cuticle.

(2) Hairs on the dorsum are more conspicuous and differently arranged.

(3) In the 3 specimens in which legs 3 and 4 can be clearly seen, they are of equal size, which excludes male Choriop-tes, but not the female. Unfortunately the pedicels and suckers cannot be clearly seen, but probably the pedicels are short and unsegmented. It is hoped to report later on the identification of these mites.

Conclusions and Summary

The "Yeti Scalp" sample shows very obvious similarity to the sample of Serow goat skin, yet is not identical with it. The differences are mostly of a kind which could occur between different individuals of the same species, or even between different body positions. Certain differences, however, are large enough to suggest that the samples might be from animals of different species or even genera. No evidence was found to suggest that the "Yeti Scalp" is actually a scalp of human or sub-human origin, and the only feature resembling any known simian sample is the asymmetrical arrangement of the pigment granules in some of the medullated "Yeti" hairs. There is no close resemblance to Blue Bear or Black Bear and only slight similarities to Yak. The differences between the mites infesting the Yeti and Serow skins may be decisive. Apart from this point of difference it could be concluded that the "Yeti scalp" was probably made from the skin of an animal closely resembling the sampled specimen of Serow, but definitely not identical with it: possibly a local variety or race of the same species, or a different but closely related species. The possibility of a much wider difference cannot however be entirely excluded on the evidence of the samples.

The following table summarises the similarities and differences between the Yeti and Serow samples.

Comparison of Samples from "Yeti Scalp" and Serow skins

1. Similarities likely to be of diagnostic importance:

- (a) Fibre arrangement in skin
- (b) "Flagging" and radial cracking of fibres
- (c) General skin structure as seen in vertical sections.

2. Similarities not likely to be of diagnostic importance :
 - (a) Scale pattern similarities
 - (b) Smooth fibre outline
 - (c) Similarities of medulla
 - (d) Pigment granule size.
3. Differences not likely to be of diagnostic importance :
 - (a) Scale pattern differences.
 - (b) Colour differences apparently due to treatment of " Yeti ".
4. Differences which may be of diagnostic importance :
 - (a) Difference in distribution of pigment granules in fibres, and especially the asymmetrical arrangement in some " Yeti " fibres.
 - (b) Difference between the ectoparasitic mites.
 - (c) The sharper scale edges and the apparently different medulla structure of the coarse " Yeti " fibres ; and the slight histological differences noted from the skin sections.

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EXPLANATION OF PLATES

- I Casts of Cuticular Scale Patterns ($\times 375$)
- (a) Large « Yeti » fibre (fig. I a).
 - (b) Large Serow fibre (fig. I b).
- II (a) Cross-section of large « Yeti » fibre showing asymmetrical pigment arrangement ($\times 600$) (fig. II a).
- (b) Mite from the « Yeti scalp » ($\times 250$) (fig. II b).